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Southern Research Institute

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June 8, 1964

Commanding Officer
U. S. Army Chemical Research
and Development Laboratories
Edgewood Arsenal, Maryland

Attention: Mr. Abraham Koblin
Contract Project Officer

Reference: Bi-Monthly Progress Report
Contract DA18-108-AMC-32-A
Design Study to Develop Instrumentation for
Field Evaluation of Chemical Agents

Dear Sir:

~~This~~ report describes the work on ~~the~~ flash camera and ~~the~~ oxime-electrochemical cell ~~during~~ April and May. The evaluation of the bread-board model flash camera was completed and detailed plans were made for completing a laboratory model instrument. The main components of the ~~laboratory model camera~~ are shown in Figures 1 and 2. Preliminary ~~specifications of the lab model camera~~ and a report on the design of the ~~electrochemical agent meter are~~ given in the following paragraphs.

~~A breadboard~~ model of the flash camera and electronic counting ~~circuits~~ was used to study the performance of a back-lighted system. The complete system will be referred to as the flash-television particle counter. The camera was arranged to view a glass slide on which particles had been deposited. With the camera set for 10x magnification, a particle of 4μ diameter produced an image that intercepted about two television lines. To measure the depth of field, the slide was moved along the optical axis until the focus-detection circuit turned off the counting circuits. This effective "depth-of-field" depends on the collimation of the light, the magnification, and the size of the particle.

The following table gives the depth-of-field for 10x, 6x, and 3.5x magnification. For these measurements the particles were illuminated with an f/1.8 optical system that gave converging light so that the included angle of the cone was 30°. Greater depth could have been obtained with

collimated light, but the light intensity would have gone down by a factor of about 30 with the same light source. For the standard one-inch vidicon television camera, the volume seen by the flash-television camera depends on the magnification and the depth-of-field. The table gives the view volume and the maximum number of particles that would be seen during each flash with a concentration of 10^4 particles/cm^3.

System Magnification	Particle Diameter (Microns)	Depth-of-field (Microns)	View Volume (mm^3)	Particles Per Flash (10^4 particles/cm^3)
10x	6	75	~.1	~1
	25	150	.2	2
	50	300	.3	3
	100	600	.6	6
6x	6	180	0.5	5
	25	300	0.8	8
	45	900	2.3	23
	100	2000	5	50
	200	3000	7.5	75
3.5x	25	300	2.4	24
	100	2000	16	160
	200	3000	24	240

Microscope objectives of 3.5x, 6x, and 10x will be provided for the laboratory model camera. The field-of-view obtained with the 10x objective is very small and it will probably be necessary to use the 6x objective for most measurements. The laboratory model counter will have ten size channels and ten counters to indicate the number of particles in a given size range. The following table shows the field-of-view and the range of particle sizes indicated by each channel for different magnifications.

Channel No.	No. of TV Lines	Particle Size Range for a Magnification of 3.5x (2.3 x 3.5 mm field)	6x (1.3 x 1.9 mm field)	10x (.8 x 1.2 mm field)
1	2-4	10-24μ dia.	6-14μ dia.	4-9μ dia.
2	5-7	25-39	15-23	10-15
3	8-10	40-54	24-32	16-21
4	11-15	55-79	33-47	22-31
5	16-24	80-124	48-74	32-49
6	25-37	125-189	75-113	50-75
7	38-49	190-249	114-149	76-99
8	50-73	250-369	150-221	100-147
9	74-99	370-499	222-299	148-199
10	100-151	500-755	300-453	200-302

These tables outline the expected performance of the laboratory model camera. For high magnifications the field of view is small and the number of particles per flash is low. However, the light source is flashing 15 times per second and 900 samples would be taken if the cloud passed through the counter in one minute. The specifications given here are based on our laboratory evaluation of the breadboard and may be changed after the lab model has been tested at CRDL.

The instrument that is shown in Figure 2 is being designed now and some parts are being fabricated. The instrument case will be waterproof so that it can be decontaminated easily. A cable will be provided to transmit the video signal to the counting circuits and the television monitor which can be located in a safe area off the test grid. The requirements of the cable are being studied. The complete system should be completed and ready for evaluation at CRDL this summer.

Work on the multiple gel-cell mentioned in the last progress letter has proceeded to the point of designing a segmented wheel cell as shown in Figure 3, Drawing 1455-D-11. However, some difficulty was encountered in obtaining the platinum part, item 1102, and the cell has not yet been manufactured.

If tests prove its feasibility, the wheel cell will be ratchet-driven on about a one-second cycle through several zones of processing. First, a reciprocating roller will apply a thin coating of methyl cellulose-oxime

gel. Second, one segment of the wheel will advance by the ratchet drive to the sampling position where the inlet air will impinge upon the fresh gel. Third, the segment will advance to a stagnant zone for measurement during the time of response of the reaction. Fourth, the segment will advance into a dip tank for washing with a reciprocating sponge or brush. It is possible that all reciprocating and ratchet motions could be achieved with a single system of linkages driven from the air pump drive so that a single motor could both drive and synchronize all functions.

The cell wheel is made of Teflon with silver and platinum sheet spun over opposite sides of the wheel, but not contacting each other. The platinum is spun to a slightly smaller diameter than the silver so that the gel layer will be thick on the platinum where electrical contact is important, and thin on the silver where rate of reaction is important.

Trials of the wheel cell will be made by hand. Only if the trials are encouraging will the complete reciprocating mechanism be made.

The most important work for June and July will be the fabrication and testing of the laboratory model flash-television particle counter. A wheel cell for the electrochemical agent meter will be fabricated and tested. If the results of these tests are favorable, a brief review of the test will be submitted to CRDL before the next progress letter so that an electrochemical agent meter can be made this summer. The project staff will remain the same as given in the last report. This report was prepared by Alvin N. Bird, Jr., and Norman L. Francis.

Yours very truly,

Norman L. Francis

Norman L. Francis
Research Engineer
Optics and Radiation Section

Approved by:

Sabert Oglesby, Jr.
Director of Engineering Research

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Chemical Procurement Agency
Edgewood Arsenal, Maryland
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Contract Negotiator and Administrator

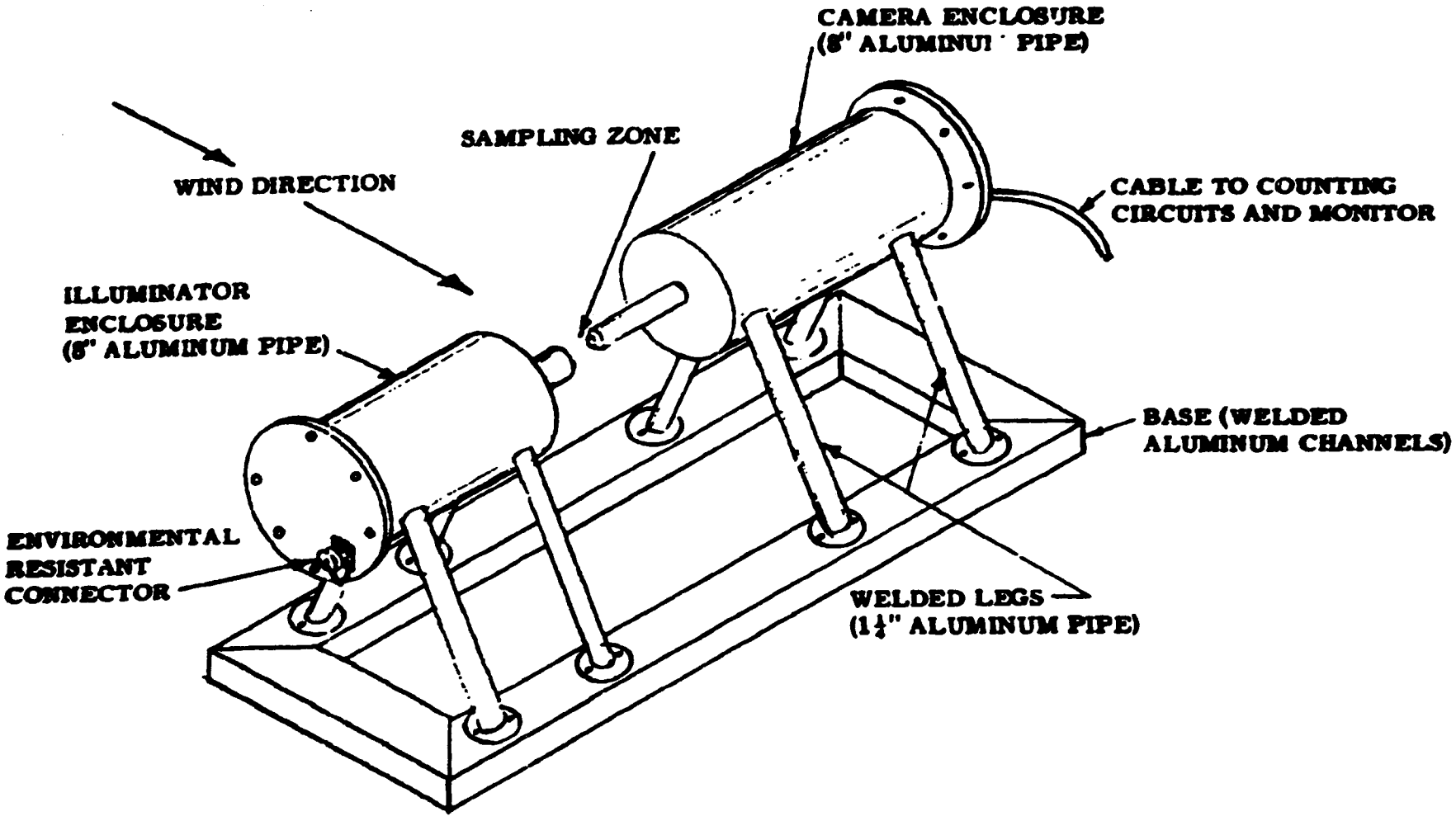

Figure 1.

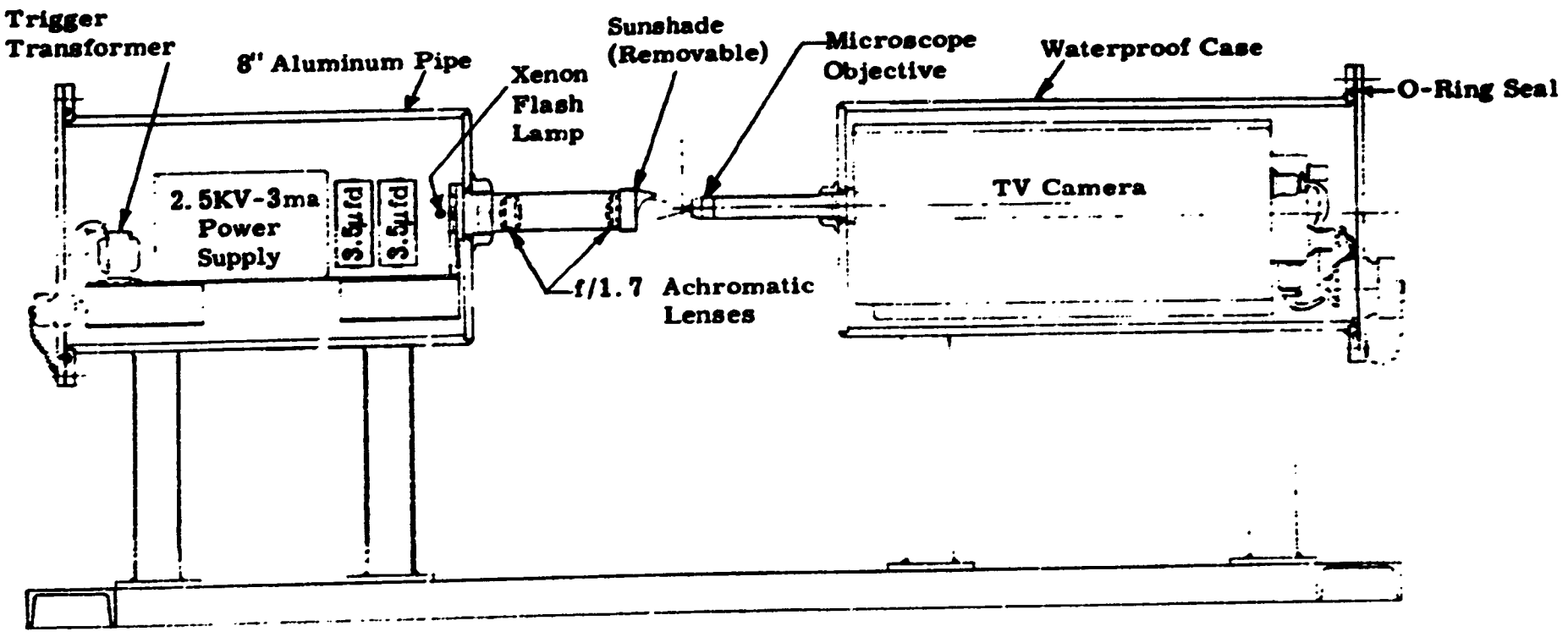

Figure 2. Laboratory Model Flash Television Camera

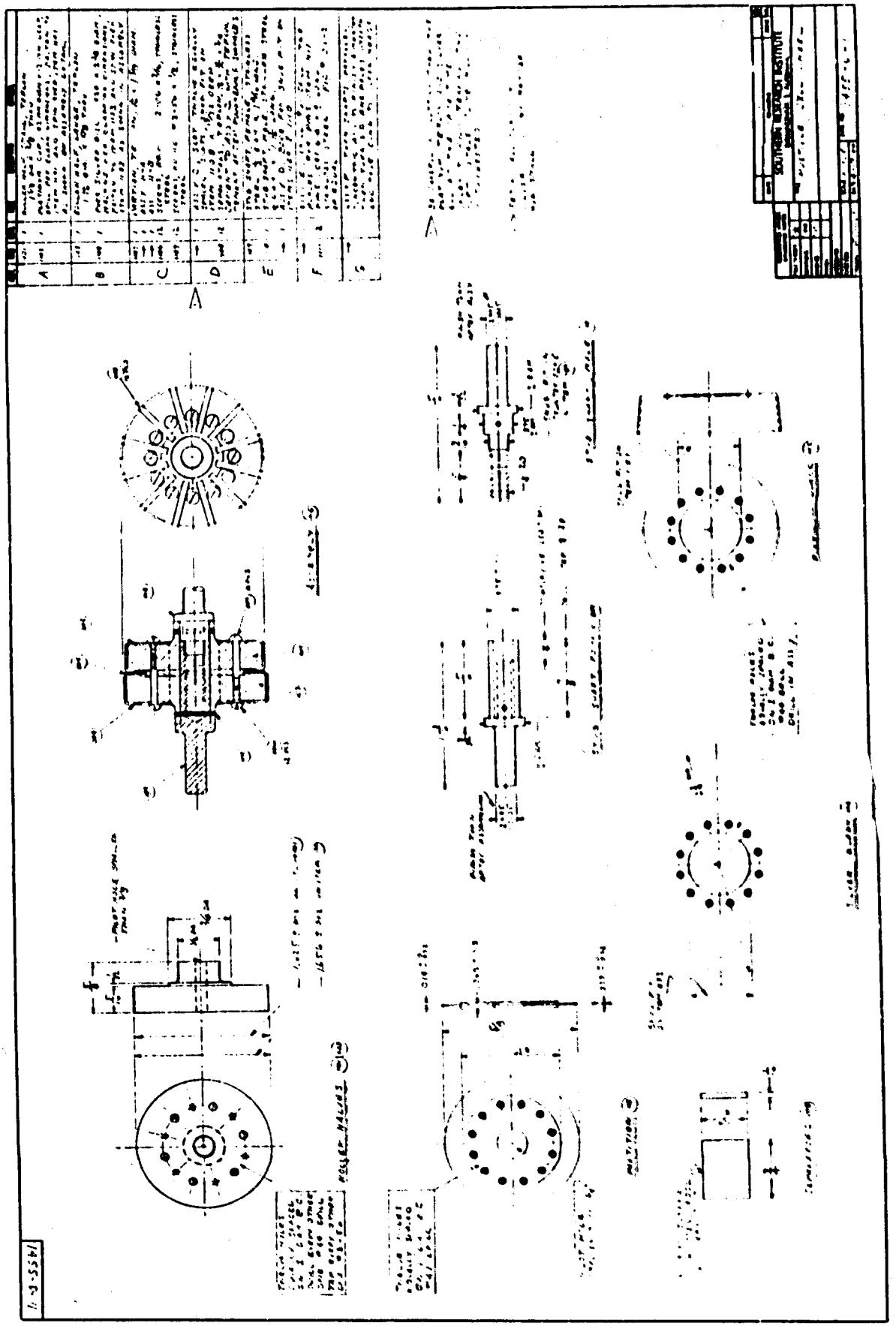

Figure 3.